

**RADIATION PROTECTION PLAN
FOR
CLEAN HARBORS DEER TRAIL, LLC**

**15.RPP.01 Revision 2
November 5, 2010**

**Clean Harbors Environmental Services
108555 East Highway 36
Deer Trail, CO 80105-9611**

APPROVALS

By signature below, the undersigned attest that the Radiation Protection Plan (RPP) documented herein meets or exceeds all applicable regulatory requirements for radiological activities at the Clean Harbors Deer Trail (CHDT), LLC RCRA Subtitle C landfill. The RPP is designed to protect employees, the public, and the environment from the potentially harmful effects of exposure to ionizing radiation from radioactive materials disposed in accordance with the limits of License 1102-01. CHDT is committed to meeting all applicable State and Federal regulatory requirements and to keeping worker and public doses from radioactive materials as low as reasonably achievable (ALARA). The license activity addressed by this Plan is the disposal of limited quantities of naturally-occurring radionuclides under 6 CCR 1007-1, Part 14. Because of the site location, the engineered design of the disposal cells, and the low concentrations of radionuclides in the materials to be disposed under the license, the relevant performance objectives will be met.

As part of this Radiation Protection Plan, the Company provides:

- Personnel instruction in radiation safety, as given by safety staff and field supervisors,
- Relevant manuals, installation and test instructions, and Standard Operating Procedures (SOPs) for equipment and activities at the Deer Trail landfill,
- Radiation safety seminars,
- A personnel monitoring system, as required (thermoluminescent dosimeters [TLDs]),
- Gate monitors, radiation monitors, air sampling, and radiation survey meters when required, and
- This Radiation Protection Plan

This RPP has been approved by CHDT corporate staff and CHDT Radiation Safety Officer (RSO).

Approved by:

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TABLE OF CONTENTS

1.0	PURPOSE AND SCOPE	6
2.0	ORGANIZATION AND RESPONSIBILITIES.....	6
2.1	FACILITY GENERAL MANAGER	6
2.2	RADIATION SAFETY OFFICER (RSO)	6
2.3	ENVIRONMENTAL MANAGER	7
2.4	LAB SUPERVISOR	7
2.5	PLANT FOREMAN	7
2.6	DEER TRAIL EMPLOYEES	7
3.0	CONTROL AND LIMITATION OF RADIATION EXPOSURES	8
3.1	RADIATION DOSE LIMITS	8
3.2	PLANNED SPECIAL EXPOSURES	8
3.3	PROTECTION OF THE EMBRYO/FETUS.....	9
3.4	POSTING	9
3.5	ROUTES OF EXPOSURE	9
3.6	RESPIRATORY PROTECTION.....	9
3.7	DETERMINATION OF INTERNAL EXPOSURE.....	10
3.8	MEANS OF EXPOSURE CONTROL	10
3.9	MINORS.....	10
3.10	WASTE TRACKING.....	10
4.0	RADIATION DOSIMETRY	10
4.1	EXTERNAL RADIATION DOSIMETRY	10
4.2	INTERNAL RADIATION DOSE ASSESSMENT	11
5.0	RECORDS	11
6.0	RADIATION SURVEYS AND INSTRUMENTATION.....	11
6.1	TYPES OF SURVEYS	11
6.2	REQUIREMENTS ON MAINTAINING RADIATION DETECTION INSTRUMENTATION.....	12
7.0	TRAINING	12
7.1	BASIC RADIATION SAFETY TRAINING	12
7.2	HAZARD COMMUNICATION PROGRAM	12
8.0	INCIDENTS AND EMERGENCIES	13
9.0	RECORD KEEPING	13
9.1	GENERAL RECORD-KEEPING REQUIREMENTS	13
9.2	INFORMATION REQUIRED ON SPECIFIC RECORDS	14
9.3	AUDITS.....	14
10.0	GLOSSARY OF TERMS.....	15

REFERENCED STANDARD OPERATING PROCEDURES

SOP Number	Title
15.RPP	Radiation Protection Program
15.RPP.01	Radiation Protection Plan
15.RPP.02	Radiation Safety Training
15.RPP.03	Worker Protection Records
15.RPP.04	Individual and Area Dosimetry
15.RPP.05	Estimating Inhalation Doses
15.RPP.06	Emergency Response
15.RPP.07	ALARA
15.RPP.08	Radiation Work Permits
15.RPP.09	Personal Protective Equipment
15.RPP.10	Determination of Prior Occupational Dose
15.WAC	Waste Acceptance and Analysis
15.WAC.01	Radioactive Materials Acceptance
15.WAC.02	Waste Tracking
15.WAC.03	Survey of Radium Scale Waste
15.OPS	Facility and Field Operations
15.OPS.01	Landfill Operations
15.OPS.02	Waste Treatment Activities
15.OPS.03	Operation of Portable Gamma Spectroscopy Unit
15.OPS.04	Operation of Alpha-Beta Smear Counter
15.OPS.05	Operation of Gate Monitor Detectors
15.OPS.06	Operation of Digital Waste Monitor
15.OPS.07	Operation of Exposure Rate/ Dose Rate Meters
15.OPS.08	Operation of Alpha-Beta Scintillation Detector
15.OPS.09	Operation of GM Pancake Probe
15.OPS.10	Operation of Gamma Scintillation Detectors
15.OPS.11	Routine Contamination Surveys
15.OPS.12	Personnel Contamination Surveys
15.OPS.13	Equipment and Vehicle Release Surveys
15.OPS.14	Spill Surveys

SOP Number	Title
15.OPS.15	Air Monitoring for Radioactive Materials
15.OPS.16	Groundwater Monitoring
15.OPS.17	Volumetric and Material Sampling
15.OPS.18	Decontamination of Surfaces and Equipment
15.OPS.19	Decontamination of Personnel
15.OPS.20	Handling of Liquids
15.OPS.21	Package Receipt Surveys

1.0 PURPOSE AND SCOPE

The purpose of this Radiation Protection Plan is to establish all necessary precautions, procedures, and plans to be observed when working directly with radioactive materials during treatment and disposal operations. This plan, supporting policies, and standard operating procedures (SOPs) comprise the Clean Harbors Deer Trail (CHDT) Radiation Protection Program (RPP), and all procedures set forth shall be strictly adhered to, by each and every designated employee, site visitor, or outside contractor who works with and around radioactive materials. It is the responsibility of the CHDT Radiation Safety Officer (RSO) to ensure that all employees, visitors, or outside contractors understand and will comply with the procedures and conditions defined in the RPP.

The procedures and policies in the RPP apply primarily to operations at the CHDT facility. Some of the SOPs are more general in nature and may be used at other Clean Harbors facilities or job sites as directed by the CHDT RSO or other Clean Harbors health and safety personnel.

2.0 ORGANIZATION AND RESPONSIBILITIES

The responsibilities for maintaining radiation safety at the CHDT facility are assigned to the following individuals:

1. CHDT Facility General Manager
2. CHDT RSO
3. CHDT Environmental Compliance Manager
4. CHDT Plant Foreman
5. CHDT Employees

The duties and responsibilities of these individuals are described below.

2.1 Facility General Manager

The Deer Trail General Manager is responsible for overall site operations. He shall ensure that supervisory and operating staff are trained in the procedures and understand them. He shall ensure that the staff have adequate resources to implement the SOPs. He shall ensure that proper procedures are followed. He has the authority to cease operations in the landfill if it becomes evident that the procedures are not being followed or do not achieve their goals. Note that these operations are consistent with those required for RCRA landfill operations, as tailored for the presence of radioactive materials.

2.2 Radiation Safety Officer (RSO)

The CHDT RSO is responsible for directing the CHDT Radiation Protection Program. The RSO is responsible for all aspects of radiation safety and for monitoring compliance with the radiation protection SOPs. He is responsible for: 1) developing the radiation safety SOPs and ensuring that the procedures are adequate to achieve their goals, 2) conducting or supervising the conduct of radiological surveys and monitoring, and 3) keeping appropriate records. He is responsible for implementing the procedures and modifying or updating the procedures, if needed. He has the authority to cease operations in the landfill if it becomes evident that the radiation protection procedures are not being followed or do not achieve their radiological safety goals. Specifically, the Deer Trail RSO shall:

1. Direct the operations of the staff regarding radiation safety;
2. Be empowered to impose conditions of work, restrictions on work, and termination of work involving regulated waste as necessary to protect personnel, the public, or the environment or to ensure regulatory compliance;
3. Review the Radiation Protection Program at least annually;
4. Serve as the CHDT's point of contact with state and federal regulatory agencies on all matters related to radiation safety;
5. Maintain a personnel dosimetry program, including evaluation of the need for issuance of dosimetry, maintain a contract for commercial dosimetry services, maintain dose records, and provide reports to individuals consistent with Colorado Regulations 6 CCR 1007-1, § 4.56 (Reports of Individual Monitoring);
6. Maintain radiation protection records including approved procedures, amendments, revisions and renewals consistent with Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50;
7. Provide radiation safety training for Company personnel;
8. Provide information and consultation on matters related to radiation safety.

2.3 Environmental Manager

The Environmental Manager shall report issues of environmental radiological noncompliance or other radiological issues to the RSO and the General Manager. (The General Manager is currently filling the position of the Environmental Manager at the time of this application.)

2.4 Lab Supervisor

The Lab Supervisor will supervise all laboratory activities including waste acceptance sampling and analysis. The Lab Supervisor is also responsible for ensuring and documenting quality control in the waste receiving process and all laboratory operations.

2.5 Plant Foreman

The plant foreman shall supervise the operating staff and make sure that proper radiation safety procedures are followed. He shall report any radiological noncompliance to the RSO and General Manager. He shall communicate problems in following the radiation procedures to the RSO and General Manager. He shall request resources to fully implement the SOPs, if needed, from the General Manager. He shall make sure that the operating staff are trained and understand the procedures. He shall suggest modification to the procedures, if needed.

2.6 Deer Trail Employees

Each CHDT employee who works with radioactive materials as outlined in this plan shall take responsibility for his or her own protection and for reporting any condition, which, in the individual's opinion, constitutes unsafe or improper working conditions. Each individual is responsible for:

1. Maintaining their own exposures to radioactive materials ALARA;

2. Following procedures and accepted safe work practices so as not to endanger him or her, the public, or the environment;
3. Reporting any unsafe working conditions, violations of the rules prescribed in this document, or violations of the applicable regulations of the state to their supervisor and/or to the CHDT RSO and;
4. Employees who may serve as visitor escorts shall point out any hazardous area that a visitor may be entering and shall ensure that all Company radiation safety rules and precautions are observed.

3.0 CONTROL AND LIMITATION OF RADIATION EXPOSURES

State and federal regulations establish a system of radiation dose justification, limitation and optimization. Individual doses are limited to ensure that immediate, deterministic effects (such as radiation burns, or skin erythema) are avoided and that total lifetime risks of chronic or stochastic effects (such as cancer and hereditary effects) do not exceed overall health risks for those persons working in safe industries. However, regulations also require that licensees further minimize radiation doses to individuals and to groups of individuals to the extent practical, which is known as the ALARA philosophy.

3.1 Radiation Dose Limits

For exposure to radioactive materials, CHDT workers shall be considered as occupational radiation workers, subject to a total effective dose equivalent (TEDE) of 5,000 millirem per year (mrem/yr) per 6 CCR 1007-1, § 4.6 in the Colorado regulations for radiation control. However, CHDT intends to maintain radiation exposures to its workers at levels ALARA, with a goal of 100 mrem/yr or less. Employee doses, both internal and external, shall be evaluated by the RSO on a quarterly basis. If it is determined from worker dosimetry results that selected worker doses could exceed 100 mrem/yr, the RSO shall conduct an evaluation of the potential for other occupational exposures for these workers to ensure that maximum individual doses shall not exceed 5,000 mrem/yr.

3.2 Planned Special Exposures

The provisions of 6 CCR 1007-1, § 4.11 allow licensees to authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under normal conditions. These provisions relate to the occupational dose limits of 5,000 mR/yr plus ALARA. However, because of the limited concentrations of radioactive materials to be treated and disposed under the license, it is highly unlikely that exposure situations will arise that could require imposition of these provisions. When special conditions are encountered that may result in significant worker exposures, exposure rates, contamination levels, and potential exposure conditions shall be determined, documented, and discussed in advance of performing the activity using SOP 15.RPP.08, *Radiation Work Permits*. The CHDT RSO shall evaluate the survey data and evaluate which controls will be required for a specific task. The CHDT RSO will gather and maintain information regarding Prior Occupational Dose in accordance with the requirements of SOP 15.RPP.10, and institute administrative controls regarding planned special exposures for individuals if needed.

3.3 Protection of the Embryo/Fetus

The provisions of 6 CCR 1007-1, § 4.13 require licensees to ensure that the dose equivalent to an embryo/fetus during the entire pregnancy, due to the occupational exposure of a declared pregnant woman, does not exceed 500 mrem, with monitoring requirements imposed under § 4.18 for those that could be exposed in excess of 100 mrem. Declared pregnant worker exposures shall be tracked and reported under the CHDT SOPs, evaluated by the CHDT RSO, and information about protection of the embryo/fetus shall be included in the CHDT training, as outlined in SOP 15.RPP.02, *Radiation Safety Training*.

3.4 Posting

Because of the anticipated low dose rates (average dose rates of less than 0.1 mrem/hr), there should be no need for posting radiation areas because of dose rates. However, posting shall be required where radioactive materials are treated or disposed. This shall include areas within the treatment building, and the landfill disposal cells.

3.5 Routes of Exposure

Exposures to radioactive materials may be received from radiation fields that are external to the body (external exposure), from radioactive materials that are inside the body (internal exposure following inhalation), or both. Inhalation of dust particles is the primary potential route of internal exposure.

3.6 Respiratory Protection

Exposure of workers to airborne radioactive materials shall be controlled through the use of full-face respirators that filter airborne particulate materials. These masks are required under the RCRA Permit as part of the CHDT Health and Safety Plan for in-cell disposal operations, waste sampling operations, and all operations in the treatment building. These masks are NIOSH-approved for particulates under the 42 CFR 84 P100 classification and are 99.7% efficient in removing particles of 0.3 microns or greater in diameter. As described in 6 CCR 1007-1, § 4, Appendix A, these respirators have a respiratory protection factor of 50. An evaluation was conducted per the guidance in 6 CCR 1007-1, § 4.24.2.1 to determine the adequacy of this mandatory respiratory protection equipment. For this evaluation, natural uranium, with a specific activity of 2,000 pCi/g was assumed with the most restrictive DAC (i.e., Class Y material, with a value of $2\text{E-}11$ $\mu\text{Ci/mL}$ in air). For dusty outdoors operations, air concentrations range from about 100 to 500 $\mu\text{g/m}^3$ (NUREG/CR-5512; Kennedy and Streng 1992). Assuming a conservative, long-term air concentration of 500 $\mu\text{g/m}^3$, the estimated activity concentration in air is $1\text{E-}12$ $\mu\text{Ci/mL}$. This concentration is about 5% of the DAC, which supports the conclusion that the respiratory protection would not be needed for protecting CHDT workers from airborne particulate radioactive material. However, since this equipment is mandatory under the RCRA Permit, further assurance is provided that worker inhalation exposures will be quite low. Procedures for estimating airborne concentrations are provided in SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. The procedure for estimating worker inhalation doses is provided in SOP 15.RPP.05, *Estimating Inhalation Doses*. Procedures for recording those doses, on a quarterly and annual basis, are detailed in SOP 15.RPP.04, *Individual and Area Dosimetry*.

3.7 Determination of Internal Exposure

Per 6 CCR 1007-1, § 4.9, estimates of internal exposure shall be made using the measured airborne concentrations at appropriate work locations to perform an assessment of the committed effective dose equivalent (CEDE). Procedures for estimating airborne concentrations are provided in SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. These airborne concentration estimates shall be used as described in SOP 15.RPP.05, *Estimating Inhalation Doses* and worker inhalation doses recorded on a quarterly and annual basis, as described in SOP 15.RPP.04, *Individual and Area Dosimetry*. Because of the relatively low concentrations of radioactive materials to be disposed, and because of the use of mandatory respiratory protection under the RCRA Permit, no bioassays will be conducted.

3.8 Means of Exposure Control

Common external exposure controls include the use of time, distance, and shielding to minimize radiation doses. These concepts are thoroughly presented in CHDT radiation safety training courses but should also be continually reinforced by field personnel through daily or weekly radiation safety briefings. Common control measures to reduce inhalation exposures include the use of protective equipment and engineering controls. Personal protective equipment (PPE) required under the RCRA Permit, including disposable coveralls, gloves, and boot covers, provide protection against skin contamination. Required protective equipment used in these operations is detailed in SOP 15.RPP.09, *Personal Protective Equipment*, the CHDT Facility Health and Safety Plan, and other corporate procedures. Engineering controls utilized to control exposure include dust control measures in the landfill cell, and the air filtration system in the treatment building.

3.9 Minors

Minor visitors to the facility shall be escorted within the site and shall not be allowed in restricted areas. Minors are not employed at the CHDT facility.

3.10 Waste Tracking

All waste that is received, treated, and disposed at the CHDT facility is tracked through operational procedures, largely developed for the RCRA permit. These procedures are provided in SOP 15.WAC.02, *Waste Tracking*, which defines the procedures, electronic files, hardcopy forms and their use in tracking waste at CHDT.

4.0 RADIATION DOSIMETRY

The purpose of the radiation dosimetry program is to measure radiation dose equivalent received by Deer Trail employees during the handling and disposal of regulated waste. The results serve to verify and document compliance with the applicable dose limits (see Section 3) and to identify problems and monitor the effectiveness of radiation safety controls. Radiation doses may be received in two ways: 1) from radioactive materials that are external to the body (external dose) or 2) from radioactive materials that are inside the body (internal dose). These doses shall be monitored when required by regulation and as described below:

4.1 External Radiation Dosimetry

Radiation dosimeters shall be issued by the CHDT RSO and worn by individual workers, visitors, and outside contractors who have been appropriately trained and who may routinely

come into contact with or are in the proximity of, radioactive materials, consistent with 15.RPP.04, *Individual and Area Dosimetry*.

4.2 Internal Radiation Dose Assessment

Consistent with the 6 CCR 1007-1, § 4.9 (Determination of Internal Exposure), for purposes of assessing internal radiation doses from the inhalation of airborne radioactive materials, suitable and timely measurements of the concentrations of airborne materials in workplace air shall be made and recorded. Airborne concentrations shall be determined consistent with SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. These airborne concentrations, in combination with estimates of the duration of exposure and the impact of respiratory controls (as appropriate), with assumptions about the physical and chemical nature of the airborne regulated waste, shall be used to assess internal dose to workers from inhalation, in accordance with SOP 15.RPP.05, *Estimating Inhalation Doses*.

5.0 RECORDS

All records of exposure, internal and external, are legal and personal documents and shall be controlled to preclude release of personnel information. All radiation protection records including individual worker records, approved procedures, amendments, revisions and renewals shall be maintained consistent with the Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50.

6.0 RADIATION SURVEYS AND INSTRUMENTATION

Radiation surveys are used to identify and quantify radiation hazards, verify contamination control, and to support the documentation of regulatory compliance. The CHDT RSO and all field personnel must work together to ensure safety in the workplace and to protect both the public and the environment from the harmful effects of radiation.

6.1 Types of Surveys

Several types of radiation surveys shall be performed supporting specific operations at CHDT. In summary, these include:

1. Waste Receipt – surveys shall be conducted to verify that incoming radioactive materials will meet the CHDT waste acceptance criteria and do not present an exposure or contamination concern. The surveys shall include:
 - a. Screening at the facility gate for gamma radiation per SOP 15.OPS.05, *Operation of Gate Monitor Detectors*.
 - b. Qualitative gamma spectroscopy screening, per SOP 15.OPS.03, *Operation of Portable Gamma Spectroscopy Unit*.
 - c. Removable contamination surveys, per SOP 15.WAC.01, *Waste Acceptance*, and 15.OPS.04, *Operation of Alpha-Beta Smear Counter*.
2. Contamination surveys for different areas at the facility, per SOP 15.OPS.11, *Routine Contamination Surveys*.
3. Personnel contamination surveys using SOP 15.OPS.12, *Personnel Contamination Surveys*.

4. Spill response surveys using SOP 15.OPS.14, *Spill Surveys*.
5. Equipment contamination surveys using SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*.

Surveys may be conducted with portable, stationary, or laboratory survey equipment. Individual SOPs for the use of each type of instrument are to be referenced prior to their use.

6.2 Requirements on Maintaining Radiation Detection Instrumentation

The CHDT RSO shall ensure that the facility maintains radiation detection equipment that is appropriate for detecting the types of radiation emitted by radioactive materials received for disposal. All radiation detection instruments shall be calibrated, as appropriate for the use of the instrument, at least annually or after repair of the instrument, to the manufacturer's specifications. Battery replacement is not cause for performing a calibration.

On each day of use, a quality control check using a check source of known radioactivity will be performed for each instrument. In addition, a background measurement will be collected. These measurements will be compared against established operating parameters to verify that the instrument is operating appropriately and consistently.

7.0 TRAINING

All CHDT employees, visitors, and outside contractors who work with or near regulated waste are required to complete radiation safety training, as described in SOP 15.RPP.02, *Radiation Safety Training*. The depth of the training shall be commensurate with the level of hazard to which the individual is exposed. All training shall be documented. No individual shall be allowed to work unsupervised until that person completes appropriate radiation safety training.

7.1 Basic Radiation Safety Training

All individuals who work with radioactive materials are required to satisfactorily complete appropriate radiation safety training course offered by or at the direction of the CHDT RSO and/or demonstrate competence on that subject matter by scoring at least 70% on a test administered or directed by the CHDT RSO. CHDT RSO-provided refresher training shall be conducted at least once each year for all individuals who work with radioactive materials. All training shall be documented and maintained on file by the CHDT RSO. Training documentation shall include content of the training (outline, course description, etc.); instructor name; date and duration of training; and the printed name and signature of trainee(s). Copies of individual employee training records are available from the CHDT RSO. Visitors who work with radioactive materials shall be required to complete training similar to that of employees. Visitors who will not be working with radioactive materials but who will enter restricted areas shall be required to be escorted at all times and undergo basic training commensurate with their potential exposure.

7.2 Hazard Communication Program

The CHDT facility has a hazard communication program as part of the Facility Health and Safety Plan maintained under the RCRA Permit. The hazard communication program utilizes waste profiles, MSDS's, labels and formal training to inform employees of any hazards of the waste materials with which they will be working. The hazard communication program shall be utilized to convey information on the specific hazards of regulated waste handled at the facility.

8.0 INCIDENTS AND EMERGENCIES

General procedures for dealing with emergency situations such as spills or accidents are detailed in the CHDT RCRA Permit Attachment 4, “Contingency Plan.” The Contingency Plan contains procedures for spill cleanup, notification of authorities, and other responses. It also provides a description of the equipment and staff available to deal with such situations. In addition, SOP 15.RPP.06, *Emergency Response*, provides additional direction on emergency response activities after an incident involving radioactive materials. In the event of a radiological incident, such as a spill or other emergency, the CHDT RSO shall be notified immediately. In instances where there is doubt about whether such notification is necessary, contact should be made to allow the CHDT RSO to assess the situation and initiate the appropriate response. If appropriate, the measures described in SOP 15.RPP.06 and the Contingency Plan shall be implemented. Radiation surveys following spills of regulated waste shall be conducted according to SOP 15.OPS.14, *Spill Surveys*.

What Constitutes an Incident or Emergency?

1. Loss, theft, or misuse of any radioactive material.
2. High or potentially high radiation exposure to an individual or to a member of the public; for example greater than 10 mrem to any offsite member of the public from an incident.
3. Intake or potential intake of radioactive materials by inhalation, ingestion, or injection through skin or wound.
4. Deceptive or potentially deceptive exposure of a dosimeter.
5. Personnel contamination that cannot be completely removed after three washes with only soap and water.
6. Any personnel injuries that may involve radioactive contamination or radiation exposure.

9.0 RECORD KEEPING

Record-keeping requirements vary and are maintained along with actual records by the Deer Trail RSO consistent with Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50. Record keeping requirements are provided in SOP 15.RPP.03, *Worker Radiation Protection Records*.

9.1 General Record-Keeping Requirements

1. The CHDT RSO shall maintain the following records in a clear, concise, and orderly format. Retention periods are included in parentheses.
 - a. Radiation surveys, as required (3 years)
 - i. Radiation field surveys for areas in proximity to regulated waste for disposal,
 - ii. Ambient radiation field surveys in unaffected areas, and
 - iii. Contamination surveys for release of trucks and equipment.
 - b. Survey instrument calibrations, as required by the manufacturer (3 years)
 - c. Personnel records (1 year post termination of employment)

- i. Worker/user lists,
 - ii. Training records.
 - d. Individual monitoring results, for routine, planned special exposures, accidents, and emergency conditions as provided by the CHDT Standard Operating Procedure on Individual and Area Dosimetry (duration of license)
 - e. Records of waste disposal as required by regulation
 - f. Annual ALARA program audits (duration of license)
 - g. Incident investigation reports (duration of license)
 - h. Declarations of pregnancy (duration of license)
 - i. Environmental monitoring data and reports (duration of license)
 - j. Operating and emergency procedures (current)
 - k. Procedure manuals from CHDT RSO (current)
2. In addition to maintaining all records in step 1, the Deer Trail RSO shall maintain the following records, which are available for review during normal office hours.
1. Copies of current state regulations relating to regulated waste,
 2. Inspection reports and copies of all “Notices of Violation” issued by state regulatory agencies and the Deer Trail responses to those Notices,
 3. Current version of all policy manuals and standard operating procedure manuals,
 4. Dosimetry records, and
 5. Survey instrument calibrations records.

9.2 Information Required on Specific Records

1. Radiation surveys
 - a. Records shall be in units of dpm, Ci, μ Ci, mR/h, mrem/h, etc., as appropriate. Units of “cpm” or “counts” are not acceptable for quantitative survey records,
 - b. Records shall clearly indicate the areas surveyed,
 - c. Records shall indicate the person performing the survey and date of survey, and
 - d. Records shall uniquely identify the survey instrument used, i.e., serial number, or other unique description.
2. Training records are specified in Section 6.

9.3 Audits

The CHDT RSO or designee will conduct periodic informal audits of the CHDT RPP throughout the year. A formal audit of the program will be conducted annually to coincide with the ALARA audit performed for the Annual Report. The audit will identify any items of concern, any equipment needs, or any other issue impacting the program.

10.0 GLOSSARY OF TERMS

“Absorbed dose” means the energy imparted by ionizing radiation per unit mass of irradiated material. The unit of absorbed dose is the Rad.

“Activity” means the rate of disintegration or transformation or decay of radioactive material. The units of activity are “disintegrations per second (or minute)” (dps or dpm) and curie (Ci).

$$1 \text{ Ci} = 37,000,000,000 \text{ dps (3.7E10 dps)}$$

$$1 \text{ Ci} = 2,220,000,000,000 \text{ dpm (2.22E12 dpm)}$$

“Agreement State” means a state that has executed an agreement with the U.S. Nuclear Regulatory Commission transferring to the state the responsibility for regulating uses of certain radioactive materials within its borders. Colorado is an agreement state.

“Airborne radioactive material” means any radioactive material dispersed in the air in the form of dusts, fumes, particles, mists, vapors, or gases.

“As low as reasonably achievable (ALARA)” means making every reasonable effort to maintain exposures to radiation as far below regulatory dose limits as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to benefits to public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of ionizing radiation and licensed sources of radiation in the public interest.

“Background radiation” means radiation from cosmic sources; non-technologically enhanced naturally occurring radioactive material, including radon, except as a decay product of source or special nuclear material, and including global fallout as it exists in the environment from the testing of nuclear explosive devices. “Background radiation” does not include sources of radiation from radioactive materials regulated by the State of Colorado.

“Committed dose equivalent (HT, 50 or CDE)” means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

“Committed effective dose equivalent (HE, 50 or CEDE)” means the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues.

“Curie (Ci)” means a unit of measurement of activity. One curie (Ci) is that quantity of radioactive material that decays at the rate of 3.7E10 disintegrations per second (dps). Commonly used sub-multiples of the curie are the millicurie, the microcurie, the nanocurie, and the picocurie.

“Dose” is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ dose equivalent, or total effective dose equivalent.

“Dose equivalent (HT)” means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are rem or mrem.

“Dosimeter” means devices designed to be worn by a single individual for the assessment of dose equivalent. Examples of individual monitoring devices are film badges, thermoluminescent dosimeters (TLDs), and pocket ionization chambers.

“Effective dose equivalent (HE)” means the sum of the products of the dose equivalent to each organ or tissue (HT) and the weighting factor (WT) applicable to each of the body organs or tissues that are irradiated.

“Exposure rate” means the exposure per unit of time, typically milliRoentgens per hour (mR/h) or microRoentgens per hour (μ R/h).

“External dose” means that portion of the dose equivalent received from any source of radiation outside the body.

“Internal dose” means that portion of the dose equivalent received from radioactive material taken into the body.

“Ionizing radiation” means any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter. Ionizing radiation includes gamma rays and x rays, alpha and beta particles, high-speed electrons, neutrons, and other nuclear particles.

“Lost or missing source of radiation” means a source of radiation whose location is unknown. This definition includes licensed material that has been shipped but has not reached its planned destination and whose location cannot be readily traced in the transportation system, and sources that may be detected and recovered by the Deer Trail gate monitors.

“Natural radioactivity” means radioactivity of naturally occurring nuclides whose location and chemical and physical form have not been altered by man.

“Quality factor (Q)” means the modifying factor that is used to derive dose equivalent from absorbed dose, per the table below:

Radiation	Quality Factor
Beta	1
Gamma	1
X-ray	1
Alpha	20
Neutron	Varies from 3 to 10

“Rad” means the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram.

“Radiation” means one or more of the following:

- (1) gamma and x-rays, alpha and beta particles, and other atomic or nuclear particles or rays; or
- (2) stimulated emission of radiation from any electronic device to such energy density levels as to reasonably cause bodily harm.

“Radiation Safety Officer (RSO)” is an individual, designated by the Company, who has the required training, knowledge authority and responsibility to apply appropriate radiation protection rules, standards, and practices.

“Rem” means the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor.

“Roentgen (R)” means the special unit of exposure. One roentgen (R) equals 2.58×10^{-4} coulombs/kilogram of air.

“Sealed source” means radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions that are likely to be encountered in normal use and handling.

“Survey” means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, and/or presence of sources of radiation. When appropriate, such evaluation includes, but is not limited to, tests, physical examination of location of materials and equipment, and measurements of levels of radiation or concentration of radioactive material present.

“Technologically Enhanced Naturally Occurring Radioactive Material (or TENORM)” means naturally occurring radioactive material whose radionuclide concentrations are increased by, or as a result of, past or present human practices. “TENORM” does not include:

- (a) Background radiation or the natural radioactivity of rocks or soils;
- (b) “Byproduct material” or “source material,” as defined by Colorado statute or rule; or
- (c) Enriched or depleted uranium as defined by Colorado or federal statute or rule

“Total effective dose equivalent (TEDE)” means the sum of the deep dose equivalent (DDE) for external exposures and the committed effective dose equivalent for internal exposures.

$$\text{TEDE} = \text{DDE} + \text{CEDE}$$

“Whole body” means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, and legs above the knees.